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Description:

General audience writeup of the kinetic-energy-supported space elevator structure concept, providing economical transportation into space at high payload volume, primary power from SSPS, including surplus power delivered to earth; spacecraft construction at GEO, Stanford Torus type space habitat construction at GEO.

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HIGHWAYS TO THE EARTH GEO RING

J. E. D. Cline

Fortunately, the resources of energy to make things happen, raw materials for building things, and vast room to live in, so needed now to take the burden of mankind's greatness off of the ecosystem of our Mother Earth, is available in space. Those resources are close, starting only ninety miles or so away, 90 miles straight up overhead, that is.

Although that ninety miles is a steep climb, one which the world is currently able to make for only a few people at a time (without much of a place to go, either; no hotels there yet) aboard chemically fueled spacecraft like the space shuttle, the key links for creating a true highway for the bulk of humanity into space may already exist in concept. Let me show you a neat design for connecting those links into a unified picture of Earth's ecological system, human civilization and highways to space habitats.

First we need a hypothetical belief that it can be done, can be achieved, and done well. That belief will lift us up out of apparent dead-end tracks along the way, energizing us with a reminder of the whole picture, the map. Yes, we CAN get there from here.

Next, a quick reminder of why we need to do it. Like humanity eliminating forever one species of earth life forms every week or so, mostly in the rainforests being slashed and burned for farm land, then exhausted to waste land. Add to the list that the arid waste lands of the entire world are collectively expanding at the rate of about 40 square miles per day. The Sahara desert once was a well-watered savannah. We are burning up many billions of dollars of fossil fuel petrochemicals every year, and replacing none of it. Worldwide we pile up one billion tons of garbage per year, putting it somewhere. OK, that is enough thinking

about this; let's not get down in the dumps with fascination about such things. Solutions are at hand, harmonious solutions. Believe.

Looking upward and outward for a new place to live for teeming humanity, let's creatively explore how to get there and where to live exactly, once there.

Chemically-fueled rocket propulsion transportation seems much too limited in this application, due to the enormous chemical energy needed to conventionally lift into space, per person. There are several billions of us needing to go, and soon, if we are to stop crushing our beloved planetary ecosystem. Most of the energy in chemical rocketry is used just to lift the fuel itself; relatively little of that fuel energy is used to lift payload itself. So let's look at the past for solutions, in light of today's technological advances.

Eliminating the fuel used just to lift most of the fuel, would make the process far more efficient. If the vehicle is already moving fast enough, say 18,000 mph, as it leaves earth surface, that would put it into orbit without lifting fuel just to lift fuel...if our atmosphere were not in the path, that is. Trying to punch its way through the air at 18,000 mph would consume its velocity and destroy it with the heat caused by shoving that much air aside that fast. Like a meteor burning up. So...let's move the air aside first, out of the path. Move the vehicle through a tube which has had all the air pumped out of it, ahead of time.

A very long tube it would be, and surely very heavy altogether. How to hold it up? By converting our 18,000mph vehicle into a steady stream of vehicles, each of which drags upward a little on the tube as it rises toward space,the tube can be supported in the earth's gravity field. Shifting our thinking a little more, convert the vehicles into just a mass stream moving at the 18,000 mph within the vacuum inside of the tube, the mass stream supports the tube by giving up a small part of its velocity, its kinetic energy, as it flows through the tube. The tube then becomes a fixed structure, attached to the earth's surface on one end. This structure could be used to move vehicles along its outer surface, like an elevator does. A "space elevator".

The elevator cars on such an elevator could lift upward by electromagnetically dragging against the upward stream of mass within the tube. Low friction tracks, such as magnetic levitation tracks, would make the process more efficient. No fuel for this process is needed to be lifted.

The mass stream in the tube travels in a circuit,returning back and forth between earth surface and somewhere in space. Ideas are built on ideas; a version proposed by Keith Lofstrom would cycle from one point on earth surface upward, across some great distance, then return to surface,be reversed, go back along the route to the starting point,all in a continual flow. Expanding on this, Earle Smith proposed a continuous flow from one point on the earth,circling out to geophysical earth orbit (GEO), continuing on around the earth to return to the initial point on the earth, again in a continuous stream. Rod Hyde proposed aversion that would essentially go straight up; the stream would be reversed in direction at its upward end, returning down alongside the upward part of the stream, back to the starting point on earth, back and forth between earth and space.

All these versions are powered by electricity. The mass stream is pushed along by magnetic fields interacting between the stream and magnetic fields alongside the tube. Rod

Hyde envisioned the stream as being composed by vast quantities of berylium disks, each with a magnet attached. The stream would be powered by electricity, and a large version consuming as much electricity as a large city, would be able to lift all the billions of humans on the planet now, out into space in just two weeks' operating time. Hyde, Lofstrom and Smith presented these concepts in 1984. Their structures are very big and expensive, and untried. Putting such structures up seems a major undertaking with much risk, even worldwide. However, these structures have the potential of being able to move the bulk of humanity out into space. If they had somewhere to go, that is. It would take a lot of courage to put such structures up, it seems.

Getting back into the creative thought mode, let's continue on with the design. Where do the people go, in space? Well, there are limits to where these elevators can go, for they are essentially compression structures,depending on compressive force to hold them together. Thus,they would not be able to go beyond the geophysical orbit;in fact, Hyde's version depends upon earth gravity to reverse the flow back toward earth surface at its upward end, thus not able to reach GEO by itself. And anything getting off these elevators short of GEO would fall back to earth, fast, unless accelerated adequately first, as in Lofstrom's Launch Loop versions. GEO, geosynchronous earth orbit, seems ideally suited for the upward terminal of such elevators, because GEO is stationary relative to the earth's surface. Thus one end of the elevator is on the earth, motionless; the upward end is stationary at GEO. Anywhere else would require relative orbital motion; the connection between elevator and upward orbital terminal then would become high-velocity, requiring complex energy exchanges as payload moves between them. At GEO, payload directly connects to the orbital terminal. Hyde's version of the space elevator might use a long tether balanced across GEO, the tether's downward end reaching the top of the elevator, so as to span the remaining distance to GEO.

Here at GEO we can build space colonies, space habitats or settlements. If we build the wheel-shaped Island One Stanford Torus space settlement design envisioned by NASA in1975 (ref. NASA SP-413,although for use at L-5 then), there is room for 1,475,000 of these wheels, if strung together like pearls on a necklace for mother earth, circling the earth above the equator, 5 earth radii above the planet's surface. In the Stanford Torus design, the wheel is over a mile in diameter, rotating so as to provide earth normal artificial gravity effects, and the wheel inner-tube is 427feet wide inside. Divided up into three sections of agriculture, alternated with 3 sections for human residence and light industry in closed ecosystems, this single ring of Stanford Torus wheel-like habitats around the earth would house up to 15 billion people, far more than the whole earth has now or possibly could accommodate well. Solar energy abounds up there, on the average seven times as much as arrives on an equal surface on the earth. Sunshine abundant for growing crops in the agricultural areas on the Stanford Torii, which in turn feed livestock and the human population.

It would be well for there to be many such elevators connecting earth to this GEO habitat ring, perhaps each nation would have at least one elevator. The initial Stanford Torii would be built from materials lifted up from the earth, along with the robotic machinery to continually build more of these habits.

Once there are these space settlements up there, a few at least, with 10,000 people each, the picture of space will look different. Building spacecraft up there, it will be relatively easy to return to the moon, from where we will get most of the structural raw materials for most of the Stanford Torus habitats to be built in GEO. Trips out to get asteroids for more material would become as common place as airplanes now land and takeoff at airports. Water and other valuable chemicals might come from the moons of the outer planets, if we choose not to take

the water from earth glaciers instead, to water the agricultural areas in thespace habitats.

Electrical power to run the space habitats comes from solar power stations, designed in the '60's. The same technology might well be used alongside each of the space elevator structures, supplying power to operate the elevators, instead of using energy from earth. Indeed, the solar power satellites could put extra energy into accelerating the elevator mass streams in the downward direction, which could be drawn off from the stream's kinetic energy at the earth surface contact sites, to supply electrical power to power whatever human civilization remains on the planetary surface. However, hopefully humanity will be responsible enough to have people only on earth surface to restore the planetary ecology, and runvacation resorts for GEO ring residents.

This overall design of kinetically-supported space elevators linking a ring of space habitats located at GEO,all powered by solar power station technology, and with transportation materials link from the ring to the moon and elsewhere in space, seems cohesive. Thus it is due further design work. To develop technology and get real-world experience with the dynamics of long space elevator-like structures, perhaps the concepts could be reduced to essences. For example, the mass stream perhaps could be glass fibers, with magnetic material embedded within the fiber at specific distances along it. These fibers could be electromagnetically accelerated within a fine tube, say 20mils in diameter. The tube would be pumped free of air, and the fibers prevented from contact with the tube walls via electromagnetic fields along the tube. With a reflector of the steam of fibers at one end, the reflection process results in a tensile force; this force could provide lift energy for the end of the tube. As in the larger versions,some of the kinetic energy of the rising high-velocity mass stream of glass fibers would be used to support the tube along its length. Steering of the rising end could be accomplished by shifting the center-of-gravity of the reflector relative to the tube, providing off-balance lateral forces, resulting in a steering mechanism. The stream would be accelerated on the earth surface; coiled prior to raising, the volume of this example would be only be equivalent to a cube 50 feet on an edge, and the length still be able to reach almost to GEO. A longer version could emplace a seed elevator of the kind that loops from earth surface, out around to GEO at the opposite side of the earth, continuing to loop back to the starting site on earth surface. Bundles of such micro-diameter space elevators might be used to support very large elevator cars going to GEO, carrying materials, tools, and personnel to build the first space habitats there.

This design for an expanding human civilization located in near-earth (GEO) space, linked directly to the earth surface by kinetically-supported space elevator structures, powered by solar satellite power technology, and a healing of the earth's ecological system, would require only technology development, not major breakthroughs in science. The untested basic concepts of elevator transportation into space need to be demonstrated to the public eye, as well as catching the public awareness for presentation of such opportunities to take the ecological load off of mother earth while at the same time provide for a greatly expanding human civilization. Given the viability of this scenario, the implementation of it would remain the decision of a responsible humanity. If undertaken as a major effort (say, using half of what each nation now spends on defense preparations each year), this would become one of the great adventures of all time for the majority of humans now living on earth surface.

References: GEnie Spaceport Library, files # 690, 671, 655, 644, 634, 629, 592, 581, 573, 563, 553, and 475.

by James Edward David Cline ("Jed")

Van Nuys, California February 9, 1989